

WHAT IS CLAIMED IS:

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1. A piezo-electric resonator comprising:  
a housing having an opening; and  
a piezo-electric resonator element provided in the housing, said  
5 piezo-electric resonator element being frequency-adjusted by a frequency adjuster  
from the opening provided in the housing.
  2. The piezo-electric resonator according to claim 1, said piezo-electric  
resonator element being a tuning fork type piezo-electric resonator element having  
two resonating arms and part of at least one of said two resonating arms being  
10 frequency-adjusted by the frequency adjuster.
  3. The piezo-electric resonator according to claim 1, said piezo-electric  
resonator element being a tuning fork type quartz resonator element.
  4. The piezo-electric resonator according to claim 2, said frequency  
adjuster being a trimming device based on laser beam or electron beam.
  - 15 5. The piezo-electric resonator according to claim 2, said piezo-electric  
resonator element being mounted on a base electrode section comprising a first single  
layer and sealed by a lid comprising a second single layer.
  6. The piezo-electric resonator according to claim 2, said opening  
provided in the housing having a size not exceeding an exterior size of the tuning fork  
20 type piezo-electric resonator element housed therein, and the tuning fork type  
piezo-electric resonator element being formed so that at least portions of both of the  
two resonating arms are exposed.
  7. The piezo-electric resonator according to claim 1, said housing  
comprising a ceramic laminated substrate, and the opening provided in said housing  
25 being metallized.
  8. The piezo-electric resonator according to claim 1, said housing  
comprising a ceramic laminated substrate, and an edge portion of the opening and a  
periphery of the opening being metallized.
  9. The piezo-electric resonator according to claim 1, a metal portion  
30 having a high thermal conductivity being formed around the opening provided in said  
housing.
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10. The piezo-electric resonator according to claim 8, a metal portion having a high thermal conductivity being formed around the opening provided in said housing.

5 11. The piezo-electric resonator according to claim 10, said metal portion formed around said opening being of a same material as a metal coating used for metallizing the edge portion and the periphery of said opening.

12. The piezo-electric resonator according to claim 10, the metal portion formed around the opening being connected to a metal coating metallizing the edge portion and the periphery of said opening.

10 13. The piezo-electric resonator according to claim 8, in a metal coating at the edge portion and the periphery of said opening, an inner peripheral edge portion of the opening being metallized into a greater thickness than other regions around the opening.

15 14. The piezo-electric resonator according to claim 9, said opening being sealed by heating said metal portion formed around the opening.

15. The piezo-electric resonator according to claim 8, a metal coating being formed to cover regions including an inner peripheral edge of said opening provided in said housing, and a sealing step being accomplished by melting a sealing material applied to the opening.

20 16. The piezo-electric resonator according to claim 15, said housing being sealed by heating a metal portion formed around the opening to melt the sealing material applied to said opening.

25 17. The piezo-electric resonator according to claim 15, said sealing material for sealing the opening being a metal alloy having a melting point within a range of from 250 to 500°C.

18. The piezo-electric resonator according to claim 17, said sealing material for sealing the opening being any one of an Au-Sn soldering alloy, an Sn soldering alloy and a Pb-Sn soldering alloy and a combination of a plurality thereof.

30 19. The piezo-electric resonator according to claim 15, said sealing material for sealing the opening being an alloy containing silver (Ag) and copper (Cu).

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20. The piezo-electric resonator according to claim 15, the opening provided in said housing being formed into an elliptic shape, and the sealing material for sealing said opening being a spherical metal alloy.

5 21. The piezo-electric resonator according to claim 15, the opening provided in said housing being circular, the sealing material for sealing said opening being a spherical metal alloy, and the sealing material having, before melting, a diameter from 1.1 to 1.3 times a diameter of said opening.

10 22. The piezo-electric resonator according to claim 20, at least two sealing materials for sealing said opening being used, and the sealing materials being a spherical metal alloy.

15 23. A manufacturing method for manufacturing a piezo-electric resonator comprising:  
forming a housing having an opening;  
providing a piezo-electric resonator element in the housing; and  
frequency-adjusting a part of said piezo-electric resonator element through the opening provided in the housing.

20 24. The manufacturing method for manufacturing a piezo-electric resonator according to claim 23, further comprising vacuum-sealing said opening in a vacuum and forming an air-tight region of the housing in which said piezo-electric resonator element is provided and vacuum-sealed, the region being formed from a single layer of a base and a lid.

25 25. The manufacturing method for manufacturing a piezo-electric resonator according to claim 23, further comprising:  
setting a sealing material on said opening; and  
heating said sealing material in a vacuum for vacuum-sealing the opening.

26. The manufacturing method for manufacturing a piezo-electric resonator according to claim 25, further including heating a periphery of said opening in a vacuum for vacuum-sealing the opening.

30 27. The manufacturing method for manufacturing a piezo-electric resonator according to claim 25, said step of heating said sealing material comprising:  
providing said housing containing said piezo-electric resonator element in a vacuum chamber; and

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irradiating a high-temperature optical beam or laser beam from outside the vacuum chamber for heating and melting the sealing material.

28. The manufacturing method for manufacturing a piezo-electric resonator according to claim 26, said step of heating the sealing material comprising  
5 bringing a heating jig into contact with said sealing material and said periphery of the opening for heating and melting the sealing material.

29. The manufacturing method for manufacturing a piezo-electric resonator according to claim 25, further including heating a lid or a base of the housing in a vacuum at the step of heating said sealing material for vacuum-sealing  
10 the opening.

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